Plant C, N, P stoichiometry was effected with nitrogen deposition on the Loess Plateau, China

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Introduction

The mass ratio of C:N:P (Carbon: Nitrogen: Phosphorus) in plant tissue can reflect the utilization efficiency of these basic elements (Piao *et al*. 2005). Additionally, the N:P ratio in plant tissue can be used to detect nutrient limitations as N, P or both are most often the driving force for ecosystem development and change (Koerselman and Meuleman 1996). N deposition has been increasing dramatically and it has great influence on the productivity, stability and nutrient supply conditions in the terrestrial and aquatic ecosystem in recent years (Wang and Yu 2008). Many scholars have focused on the C:N:P stoichiometry of individual plant or the whole plant communities which were based on weighted average of important key species and their element contents, rather than by collecting biomass samples of all the plants in the community level. Moreover, less is known of the effects of N deposition on C:N:P stoichiometry characteristics of plant communities, especially the grasslands of the Loess Plateau. An experiment was set to study the effects of N deposition on C, N, P stoichiometry characteristics by simulating N deposition by way of N addition.

Methods

The study was conducted in a fenced grassland at the Semi-Arid Climate and Environment Observatory of Lanzhou University (*SACOL*), located at 35°57′ N; 104°09′E (Gansu, China) with a continental semi-arid climate in *Loess Plateau* (Li *et al*. 2008). Four levels of N additions (N 0: 0.0gN/m^2/a, N 1: 1.15g N/m^2/a, N 2: 2.3 g N/m^2/a, N 3: 4.6 g N/m^2/a) were supplied on individual plots (4×5m^2 each) in June and July every year (began in 2009). Plant samples (all the plants within a square) were taken on September 26, 2011 and then oven-dried. Grounded dry samples were used for determining C, N, P content. P was determined by Mo-Sb colorimetry. C, N was determined by CHNS-O Analyzer (Flash-EA-1112, Thermo Fisher Scientific, Waltham, MA, USA).

Results

In this study we found that plant N content increased significantly with the increasing of N addition (Fig. 1A) while C and P kept constant (Fig. 1B, Fig. 1C). The C:N, C:P and N:P ratios varied greatly under different N additions. There was a significant decline (P<0.05) in C:N ratio with N additions (Fig. 1D). This indicates that the utilization of N decreased on the community level with the increasing of N addition. However, the C:P ratio remained constant compared with N0 treatment, which could be attributed to the drought condition in the measuring year (Fig. 1E). The N:P ratio is widely applied to diagnose relative limitation of N and P to plant growth with growth limited by N when N:P <14, but limited by P when N:P >16. Moreover, plant growth would be limited by both N and P when the ratio is between 14 and 16. (Koerselman and Meuleman 1996; Bott *et al*. 2008). This suggests that plant growth in Loess Plateau is mainly limited by P. Furthermore, N addition enhanced the restriction by P (Fig. 1F).

Conclusion

The N content increases significantly with the increasing of N addition in the plant community while C and P remained constant. So as a result that the C:N ratio decreases, N:P increases with the increasing of N deposition. However, the C:P ratio remains unchanged.

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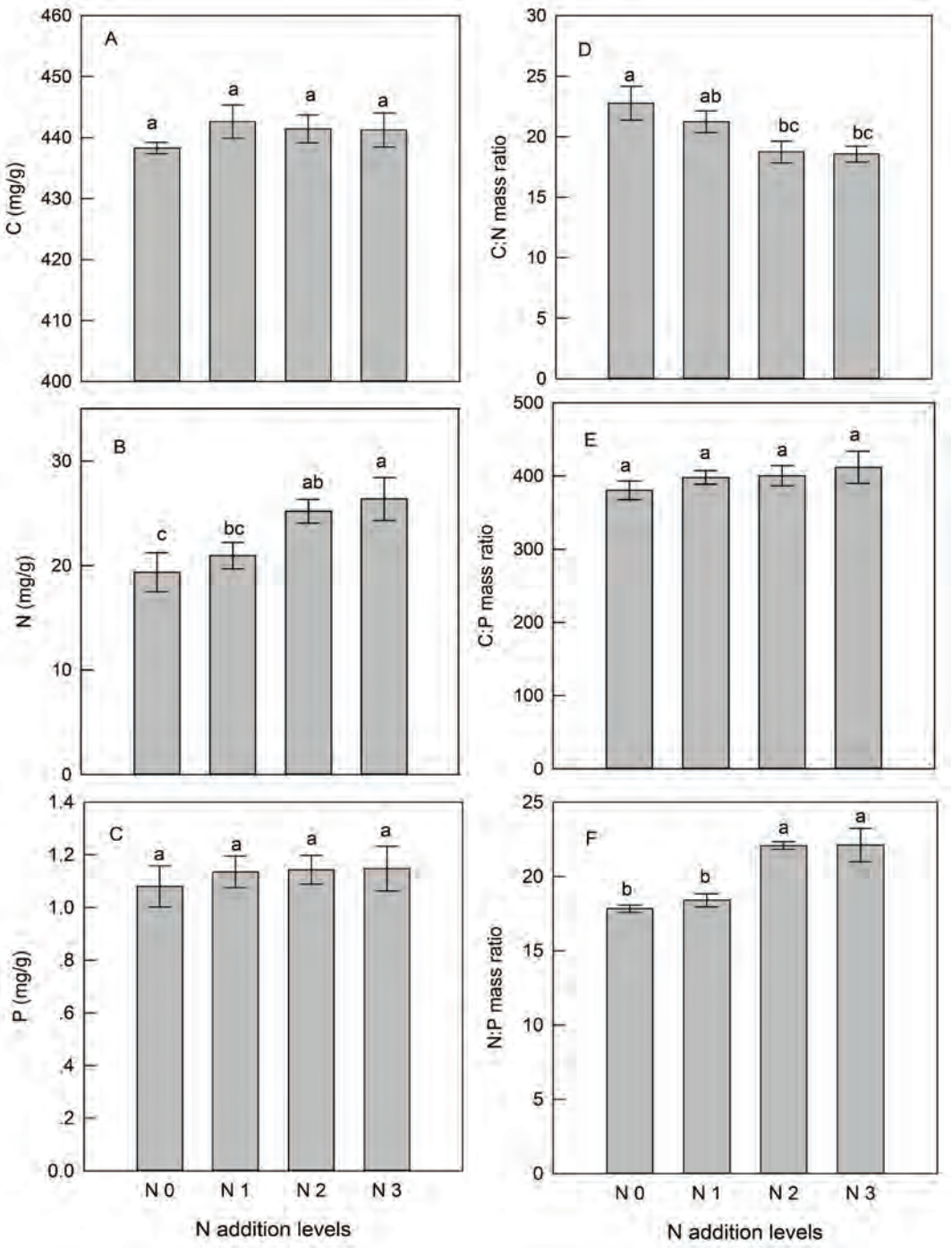

Figure 1. Effects of nitrogen addition on C, N, P content and C: N: P stoichiometry of the plant community. Different lower-case letters indicates significant differences between treatments (P<0.05).